CIREN

Kids In Crashes: The Real World Consequences of Child Restraint Misuse

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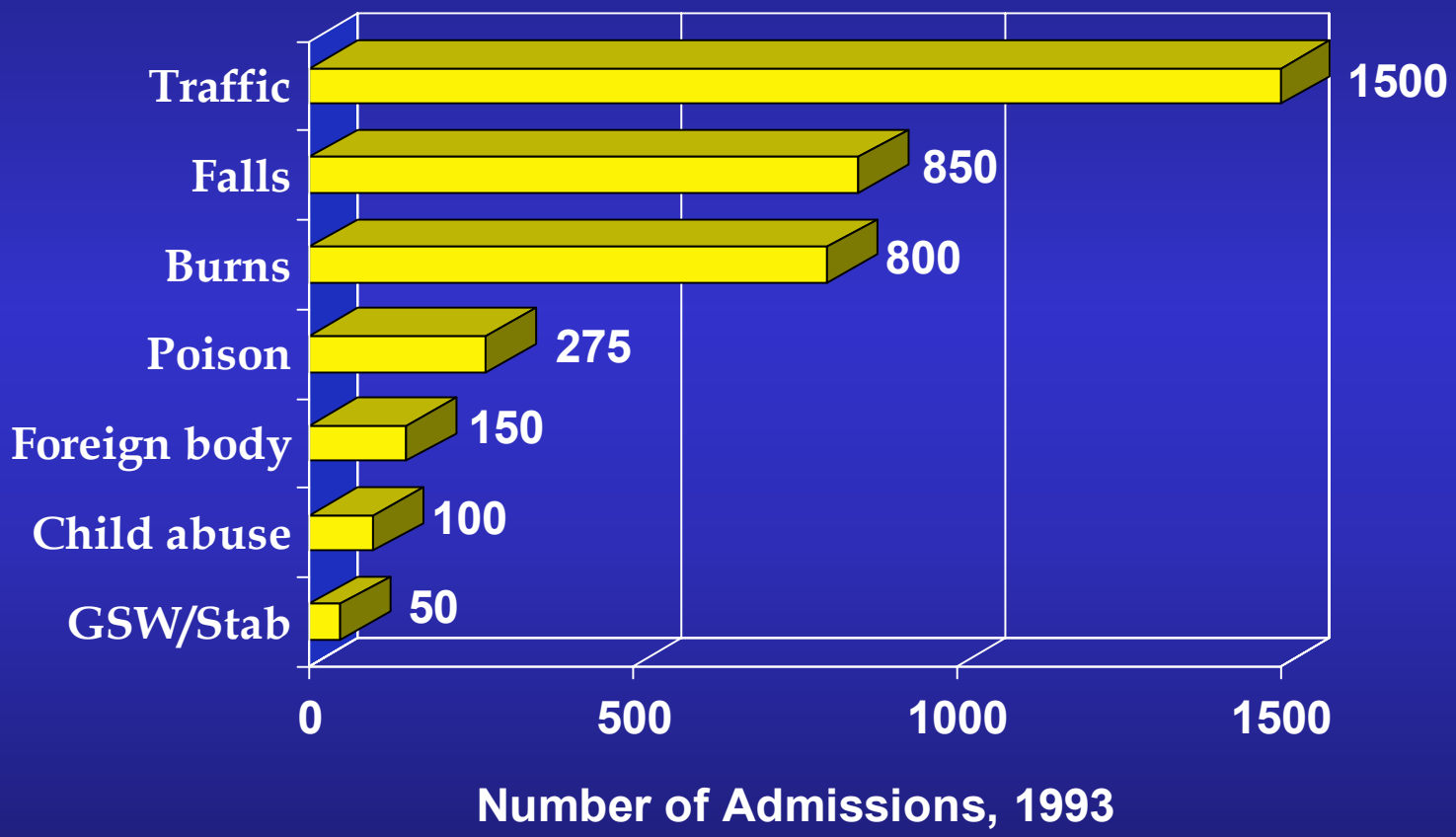
Presentation Overview

- **Patient Population**
- **Restraint Type Analysis**
- **Injury Analysis**
- **Crash Type Analysis**

Children's National Medical Center

Trauma Admissions

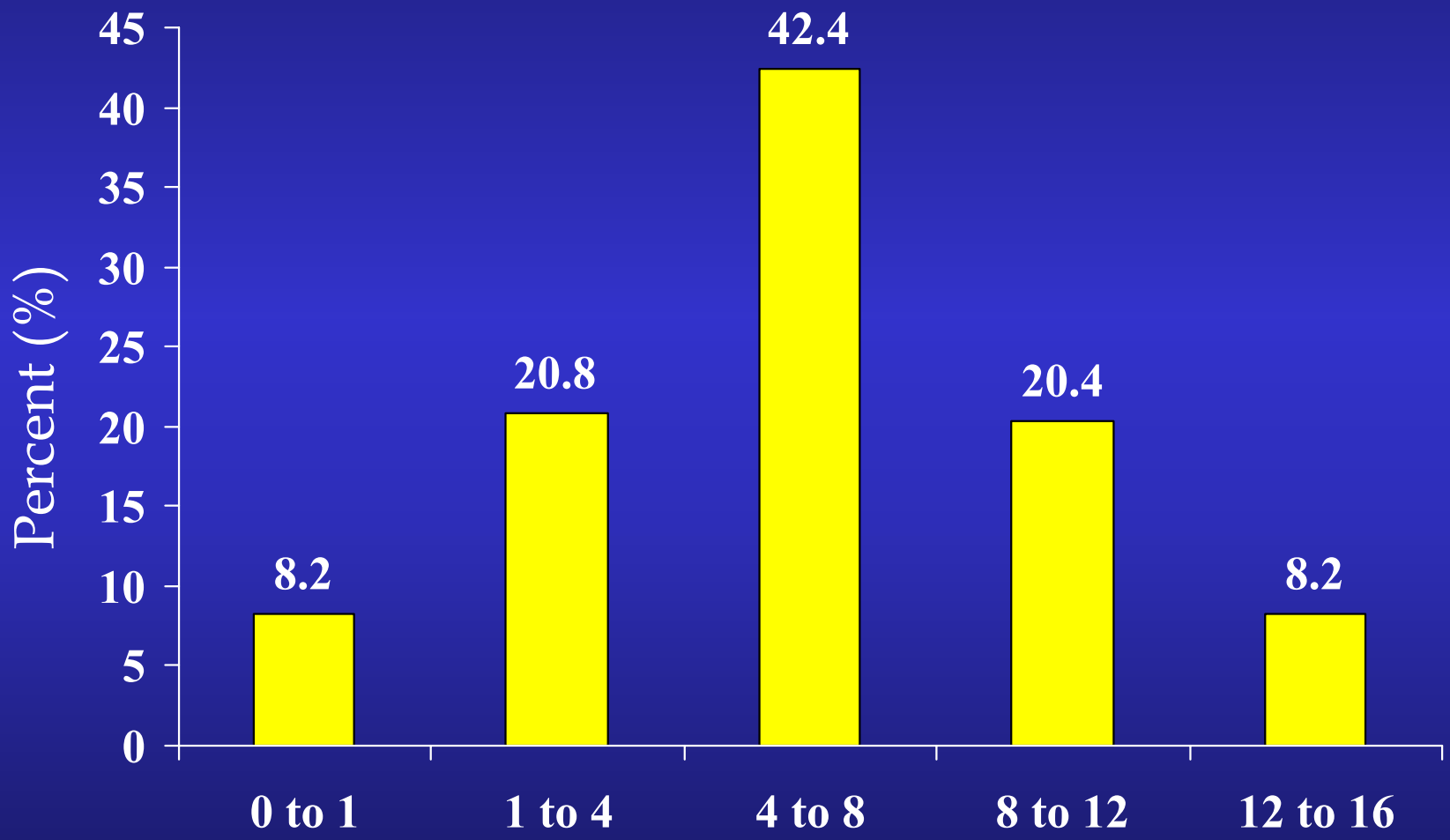


Data Summary
245 Children*

	Mean	Range
Age	6.16 years	(0-16)
Length of Stay	5.2 days	(0-96)
ISS	12.36	(1-75)
Cost	$24,472	(0-1/2 mil)
Delta V	22.96 mph	(4-55)

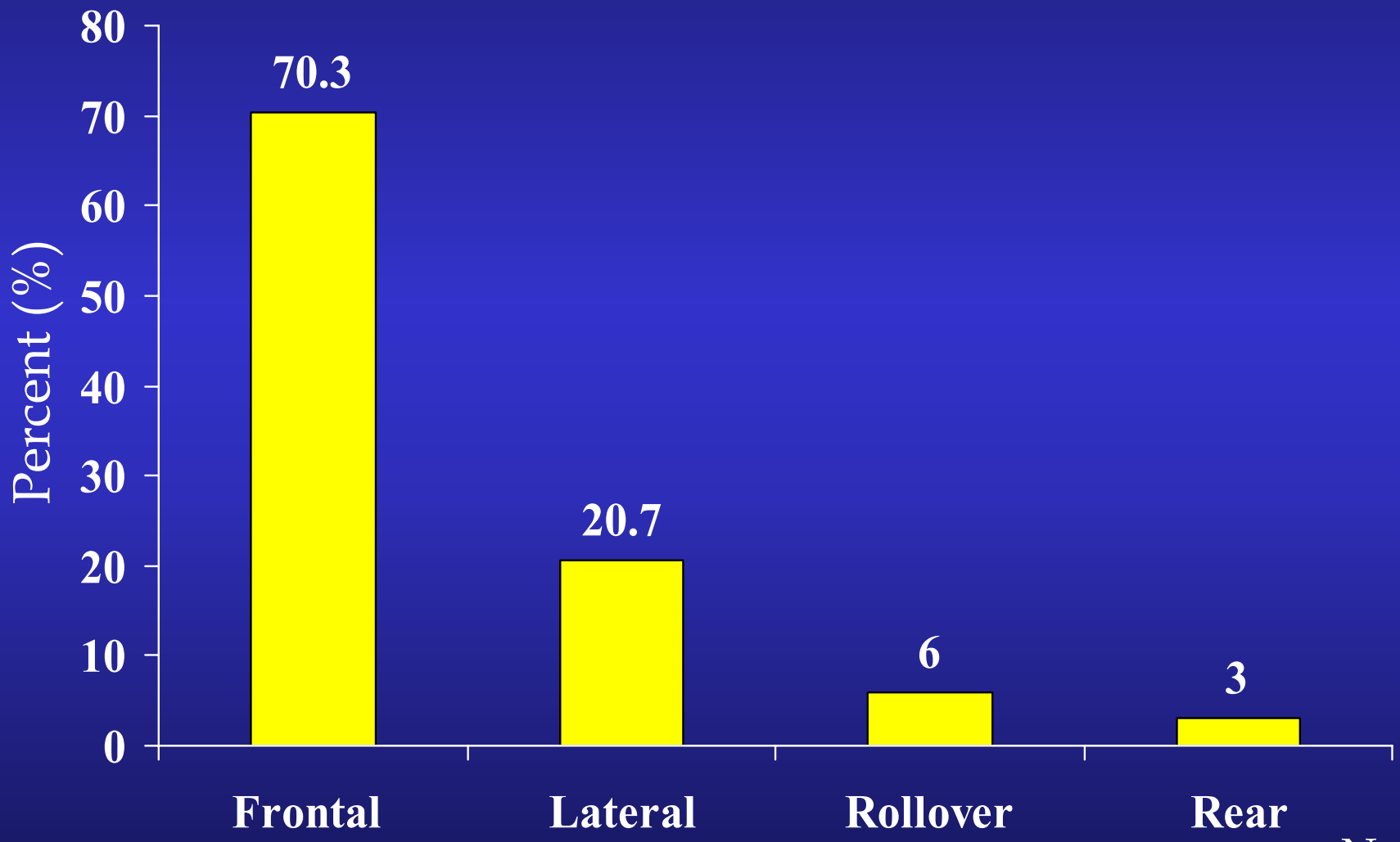
*Mortality (n=10) 4.2%

Age Distribution



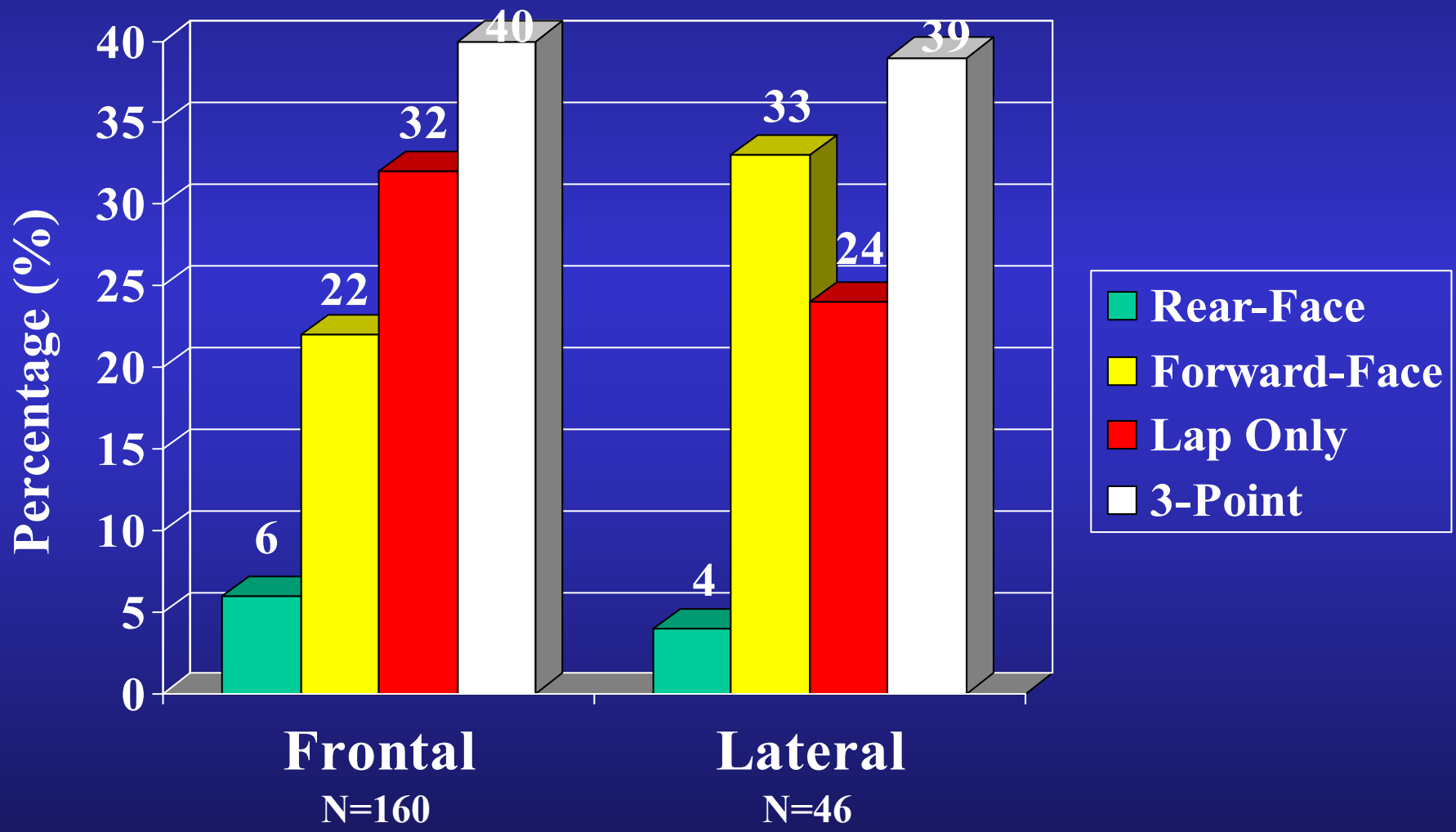
N=245

Crash Type

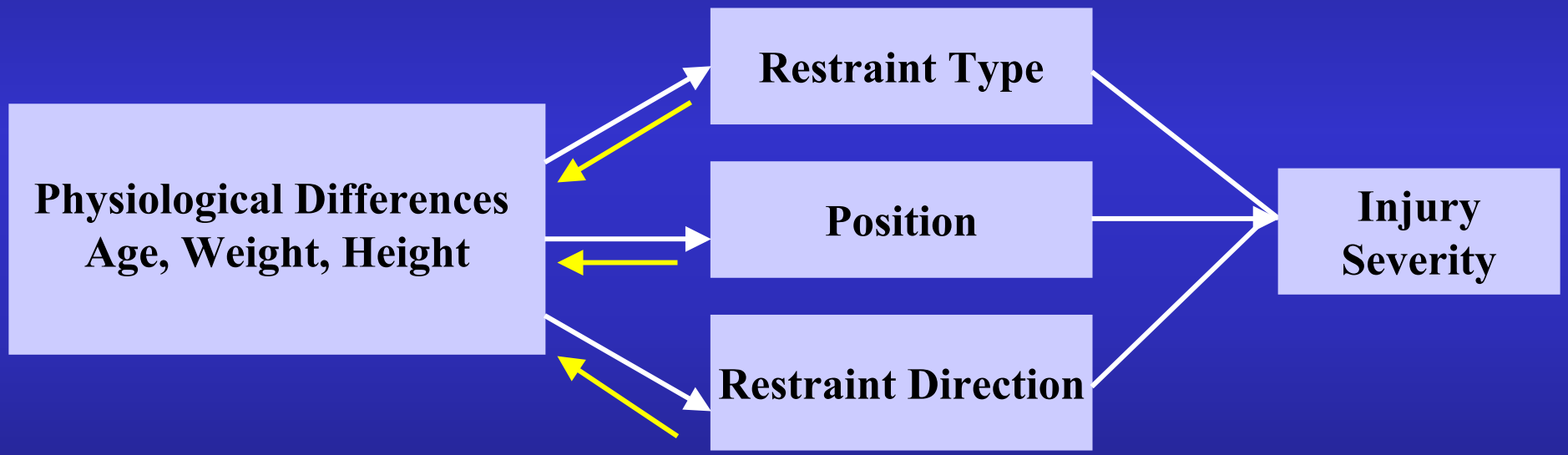


N=245

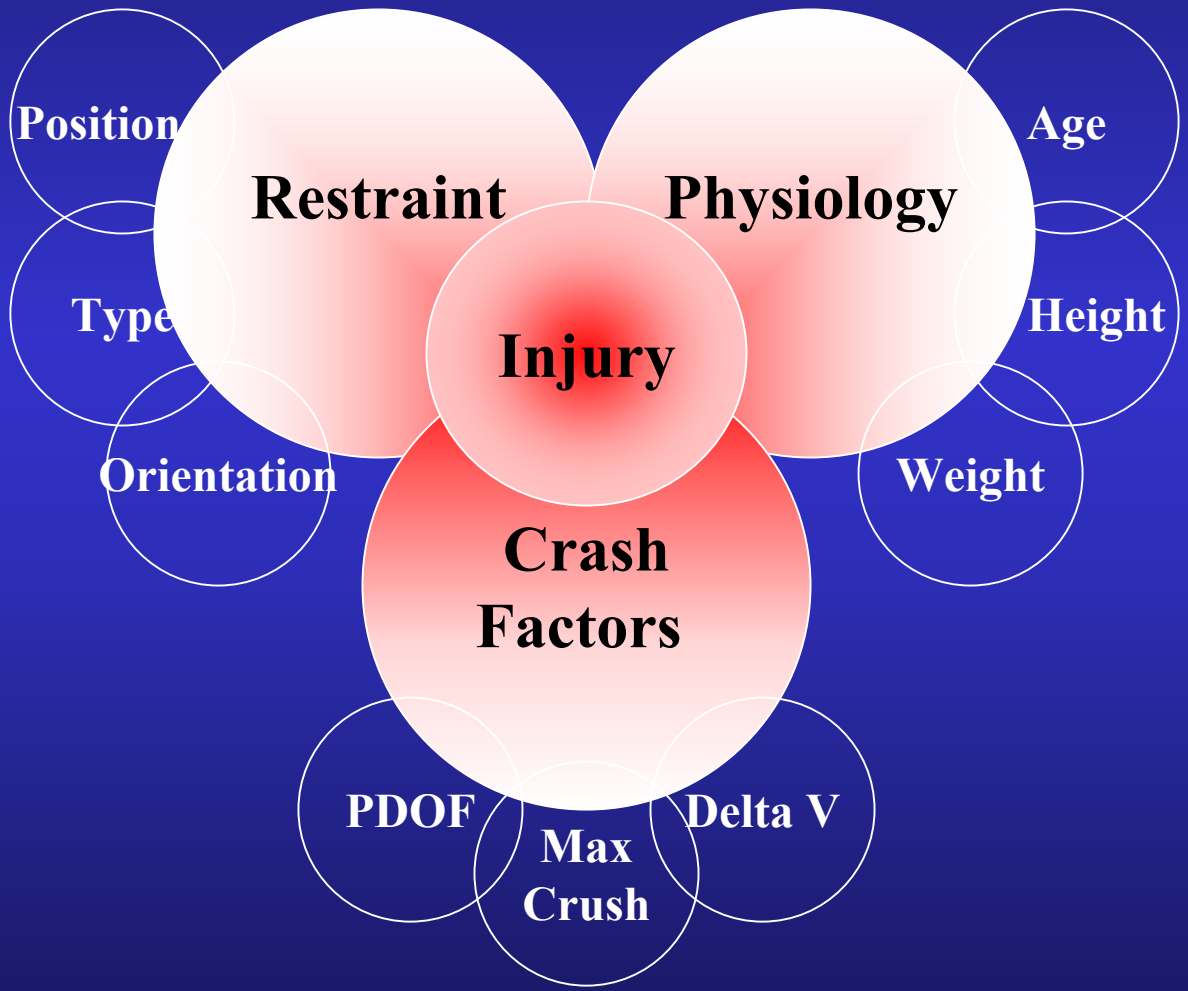
Restraint Type



Kids Are Different!



Motor Vehicle Injury Variables



Restraint Type Analysis

Types of Child Safety Seats

1. Infant Only

2. Convertible

3. Booster

INFANT SEATS

- < 1 year
- < 20lbs.
- Rear-Facing Only

CONVERTIBLE SEATS

- < 20 lbs
- Rear-facing

- 20-40 lbs
- Forward-facing

BOOSTER SEATS

Belt-positioning Booster (NHSTA)

- Is child against the seat back
- Do the knees bend at the edge of the seat
- Does the shoulder belt cross the center of the clavicle bone
- Does the lap belt touch the top of the thighs
- Can the child ride like this the whole trip

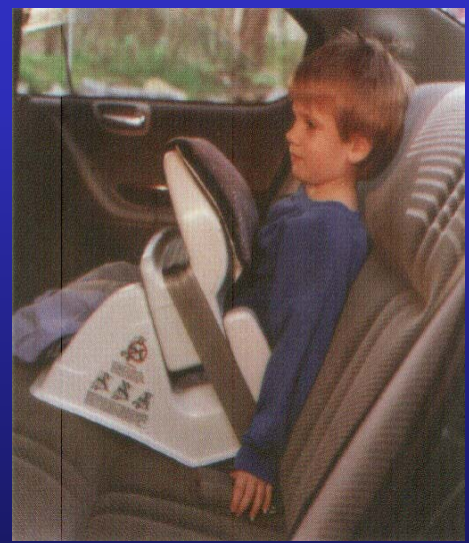
Legislation guidelines

-age based

-weight based

Shield Booster

- No longer recommended



Seatbelt Readiness

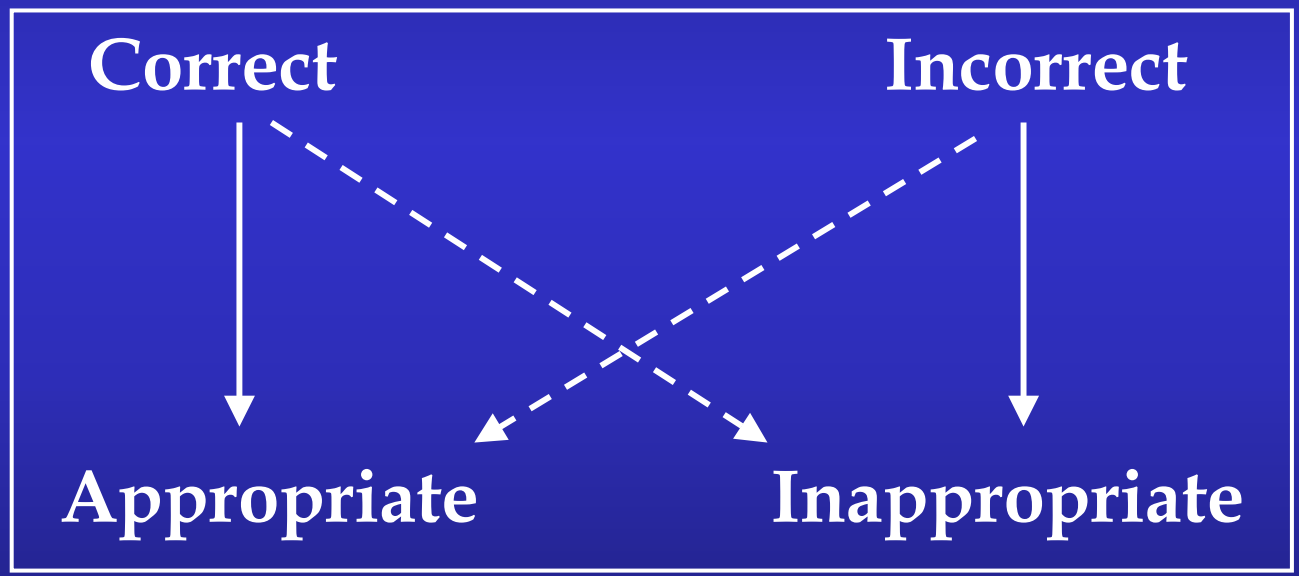
- 3-pt. Lap/shoulder belt:

Inappropriate

5 point Test

Appropriate

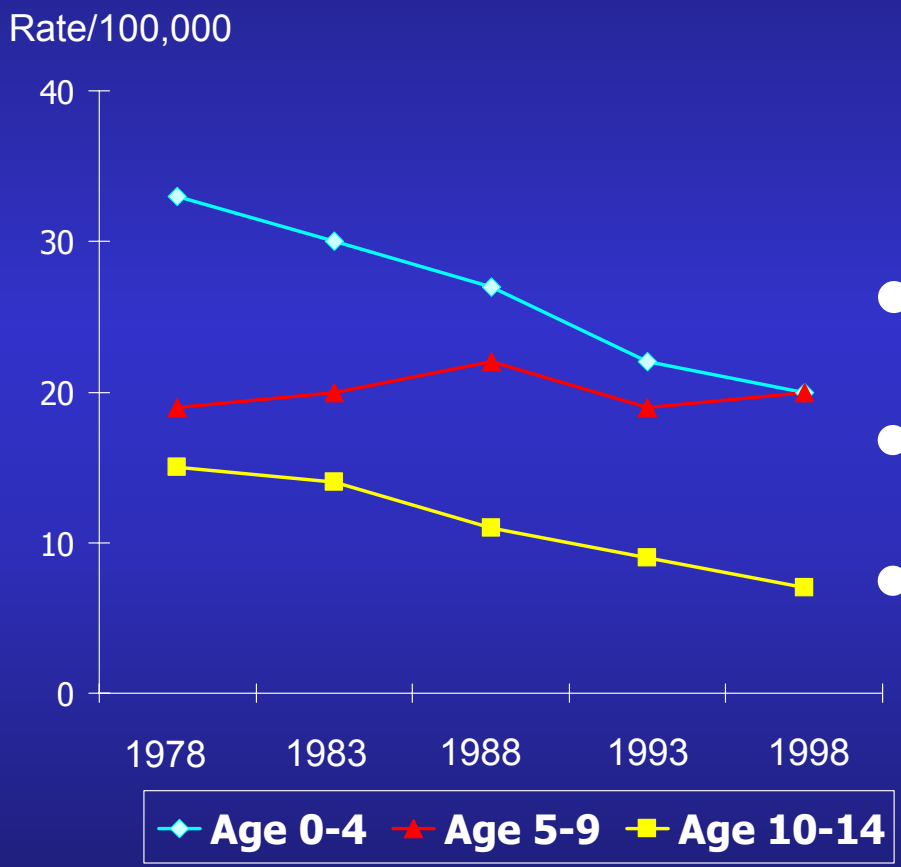
Child Restraint Use/Misuse



Child Safety Seat - Misuse

proper restraint for child but not correctly used)

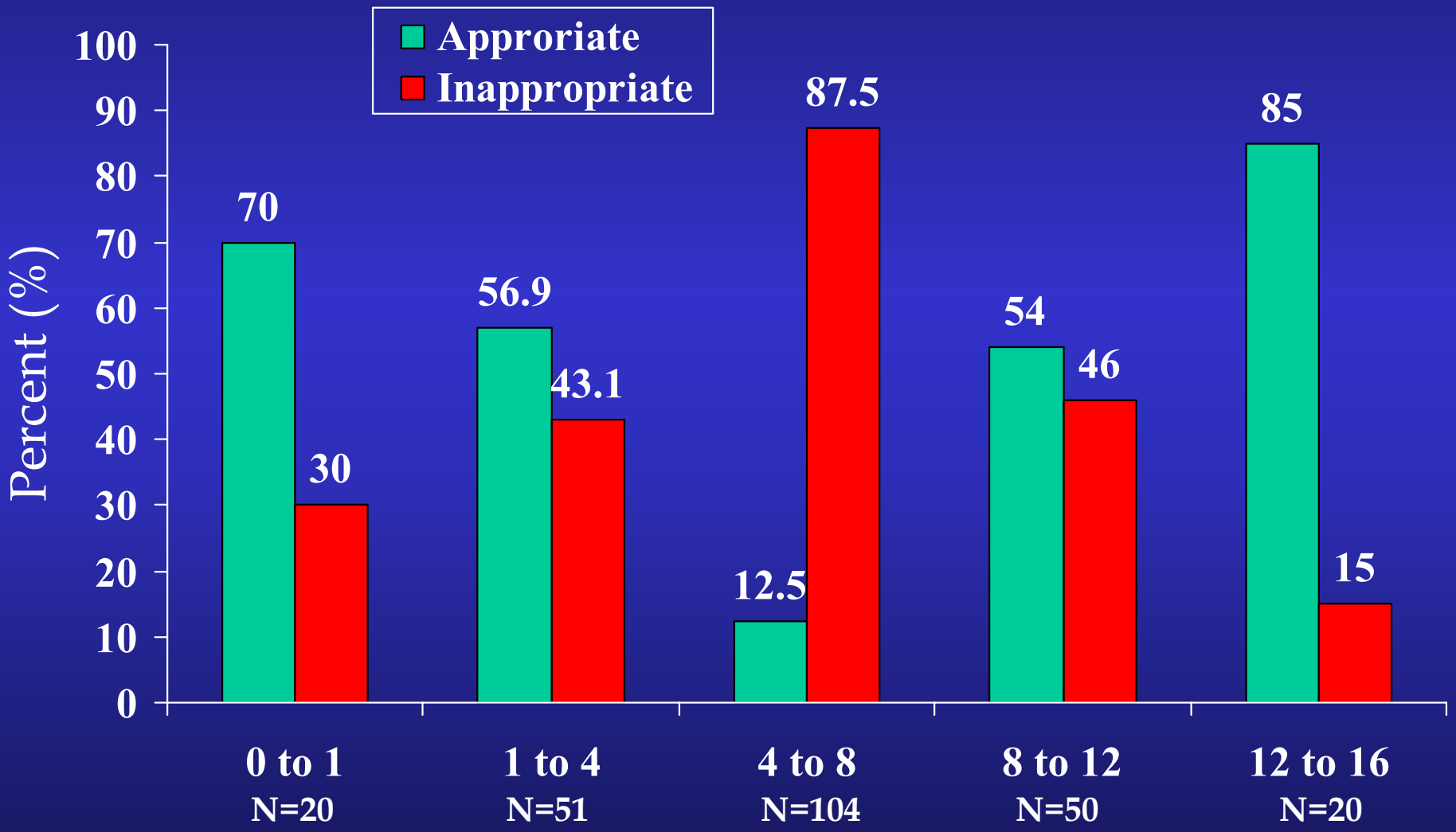
Trends in MVC Mortality & Morbidity 1978-1998



- **Children 0-4 yrs: 35%** ↓
- **Children 5-9 yrs: unchanged**
- **Children 10-14 yrs: 15%** ↓

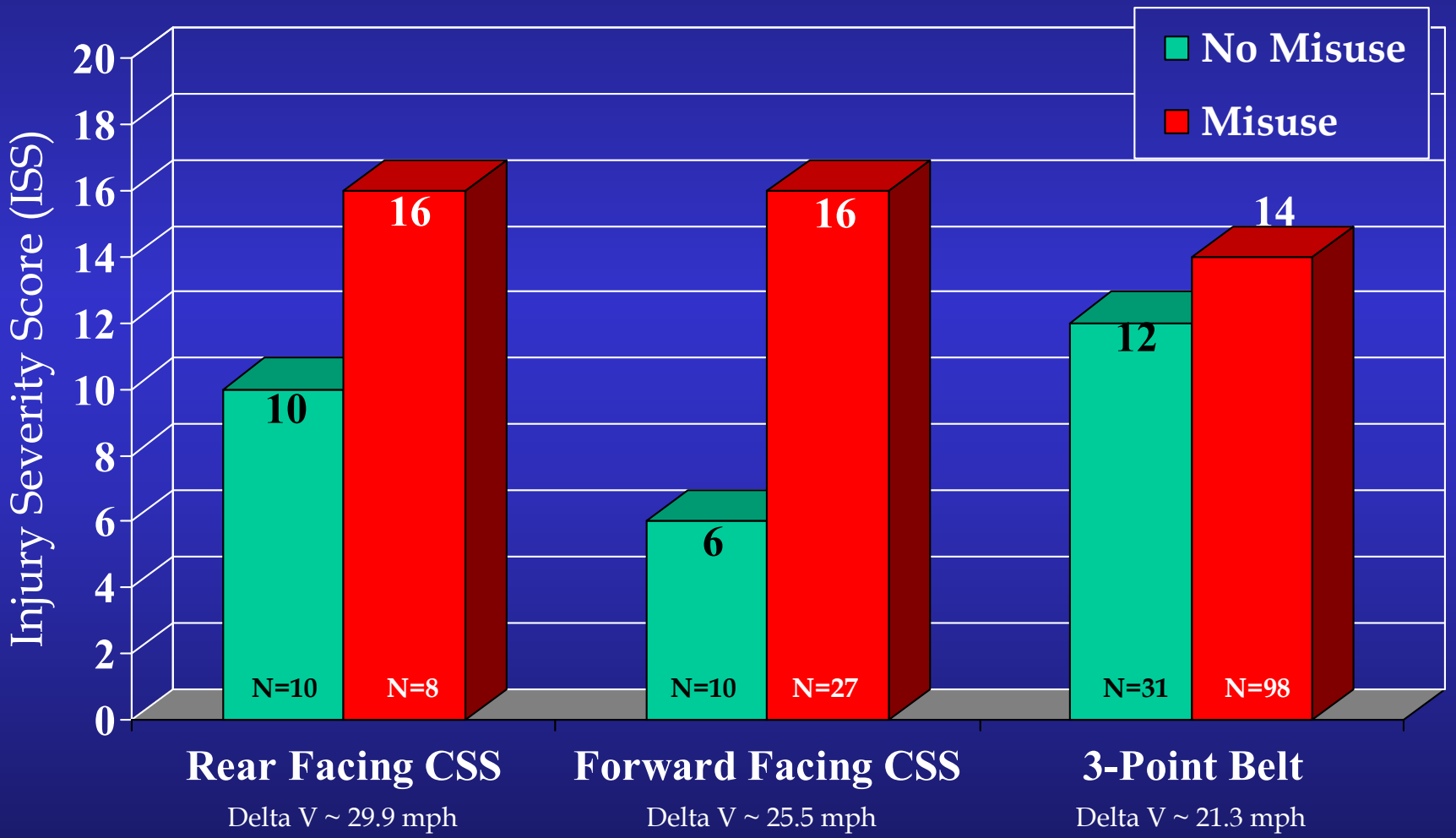
Source: Traffic Safety Facts 1998, US DOT/NHTSA

Appropriate Restraint Use



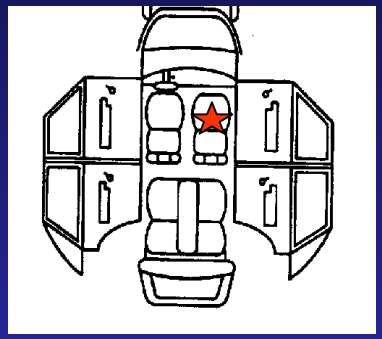
Inappropriate Use: not appropriate for child

Comparison of children properly restrained for age versus those that were not (misuse)



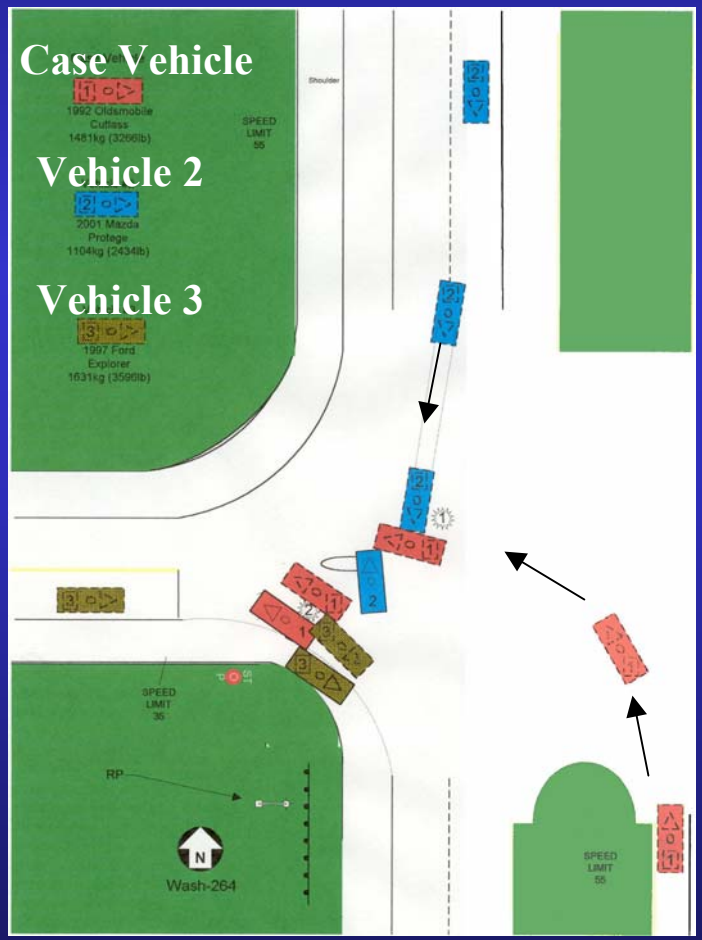
Case Example: Inappropriate Restraint

- **Lateral Impact**
- **7-year old male**
- **55 lbs., 47 in.**
- **Front Passenger**
- **3-pt. Restraint**
- **Inappropriate**



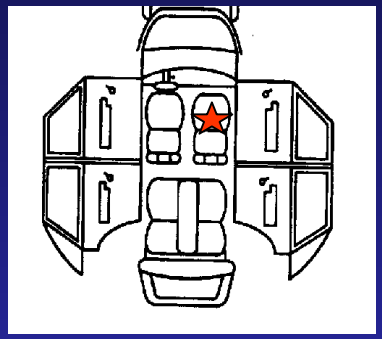
Scene and Auto

Crash Investigation



- 1991 Oldsmobile Cutlass
- Lateral Impact

- Max Crush: 23.6 in.
- Delta V: 24.2 mph
- PDOF: +100

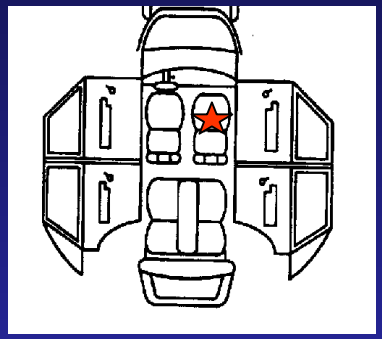


Brain Injury

Shear Injury

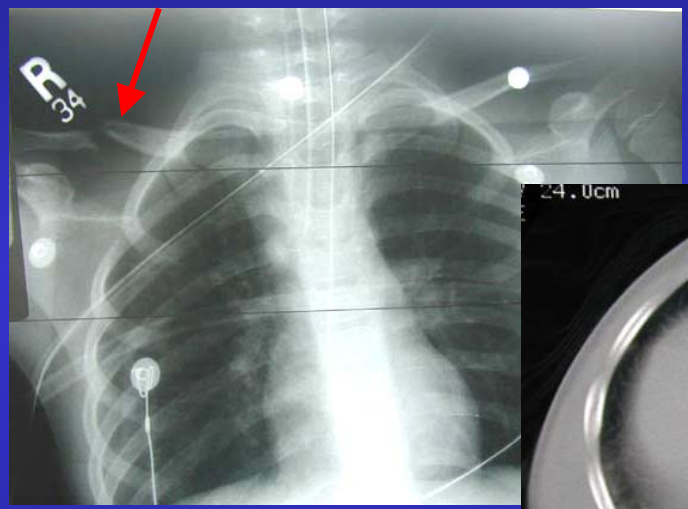
Diffuse Blood

Left Parietal Hemorrhage

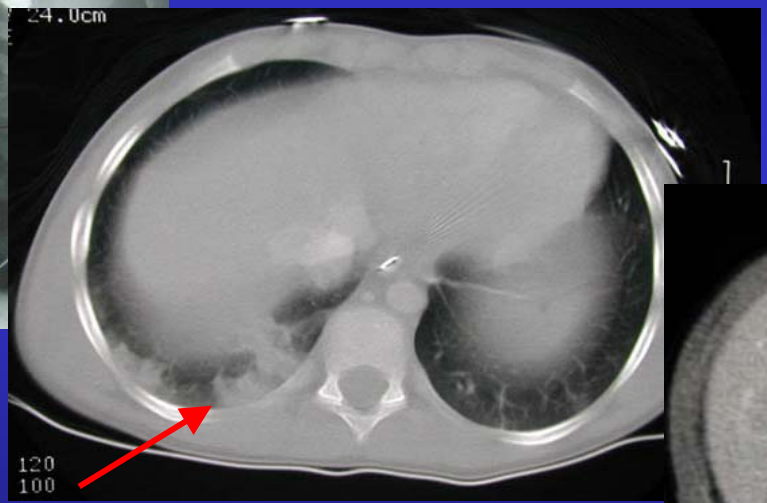


Other Injuries

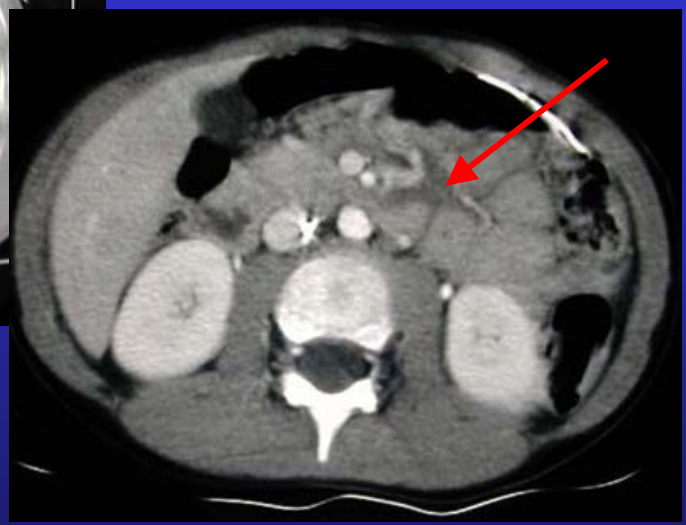
Fractured Clavicle



Lung Contusion



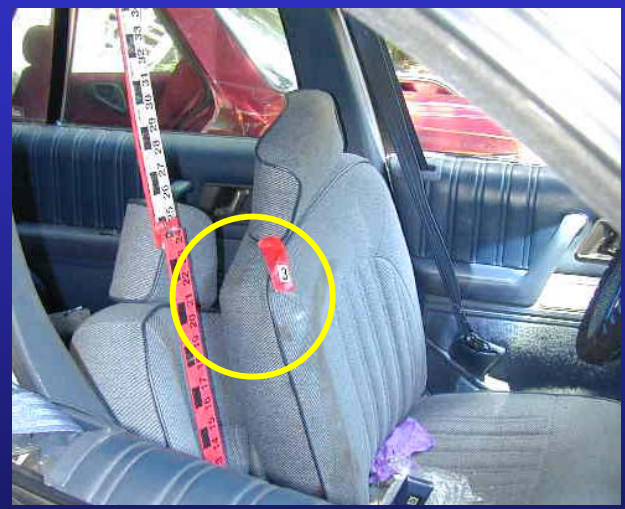
Abdominal Free Fluid



Putting It All Together:

Left Parietal Hemorrhage

Driver Seat Contact



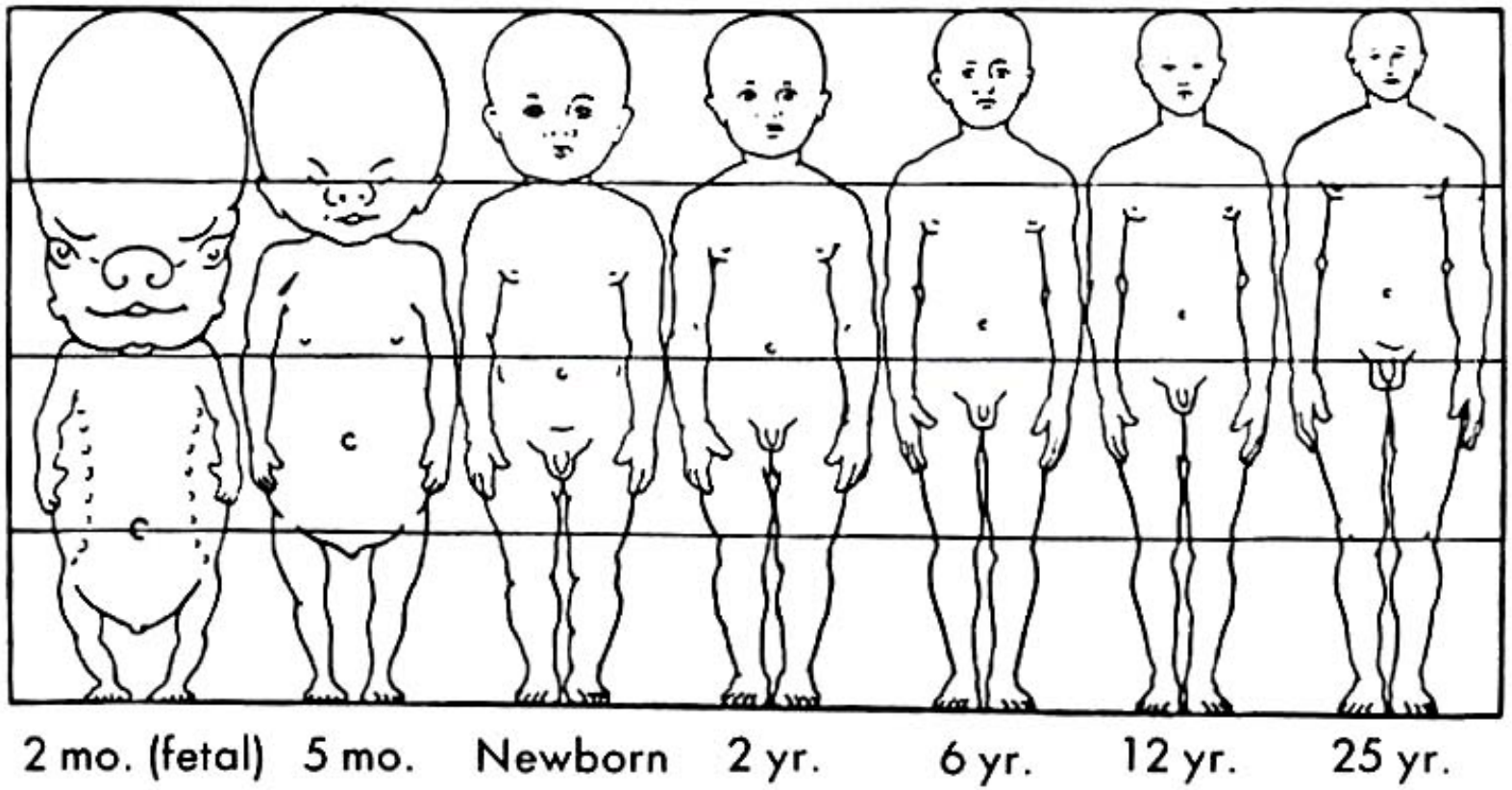
Restraint Type

- Injury severity varies by restraint system
  - seat belt>forward facing>rear facing
- Injury severity is greater when misuse is present
- Still many unanswered questions about booster seats
  - data lacking

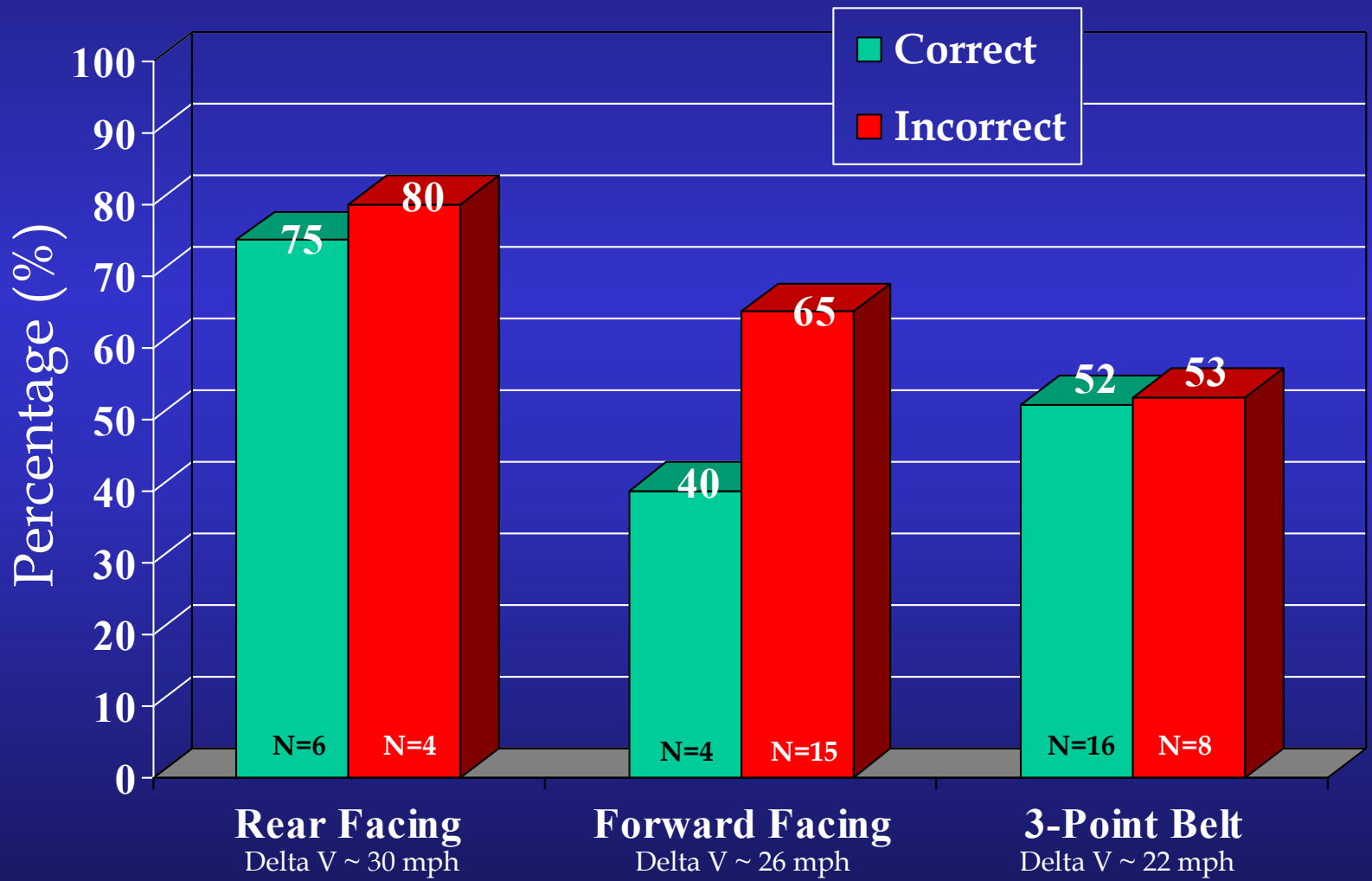
Injury Analysis

The head remains the most vulnerable body part for children

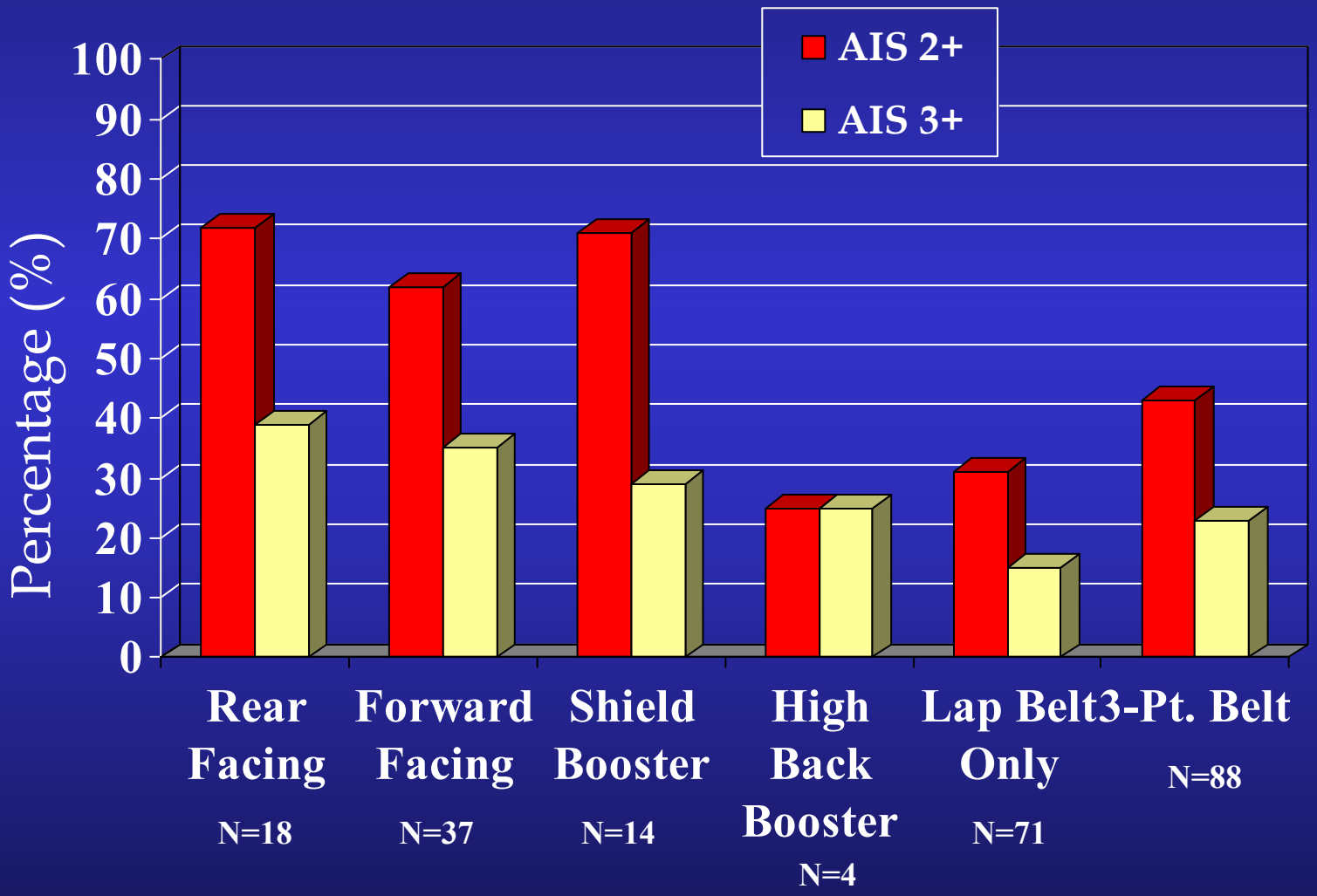
Pediatric Head



Correct vs. Incorrect: AIS 2+ Head Injury



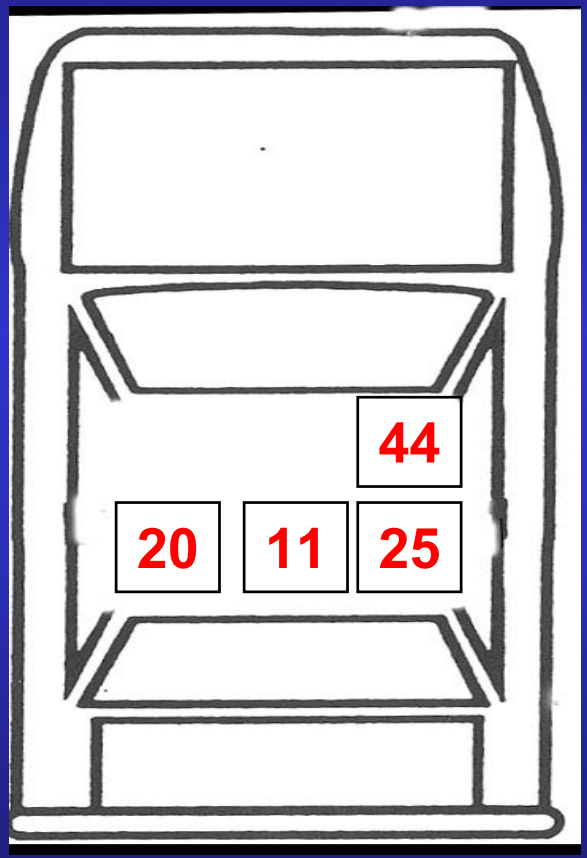
Head Injury Associated with Restraint Type



Crash Types

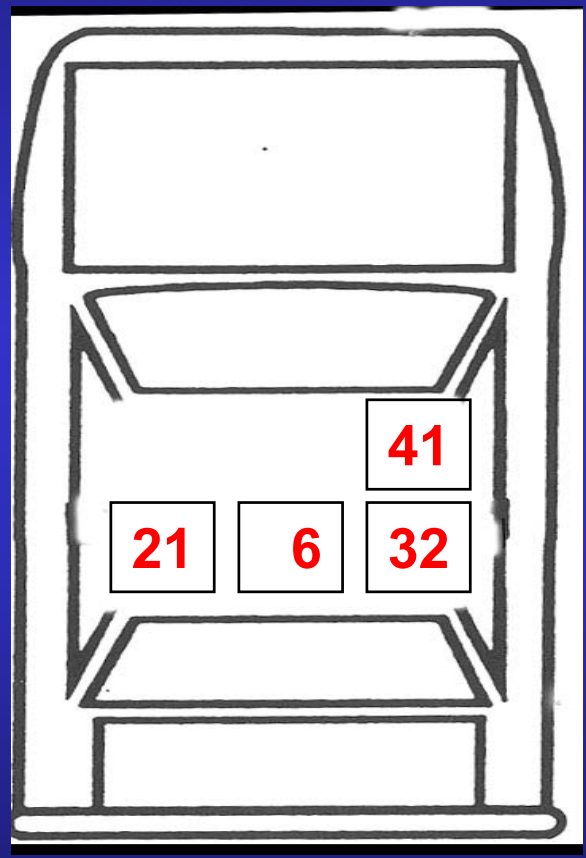
Frontal vs. Lateral

Seating Position by Crash Type



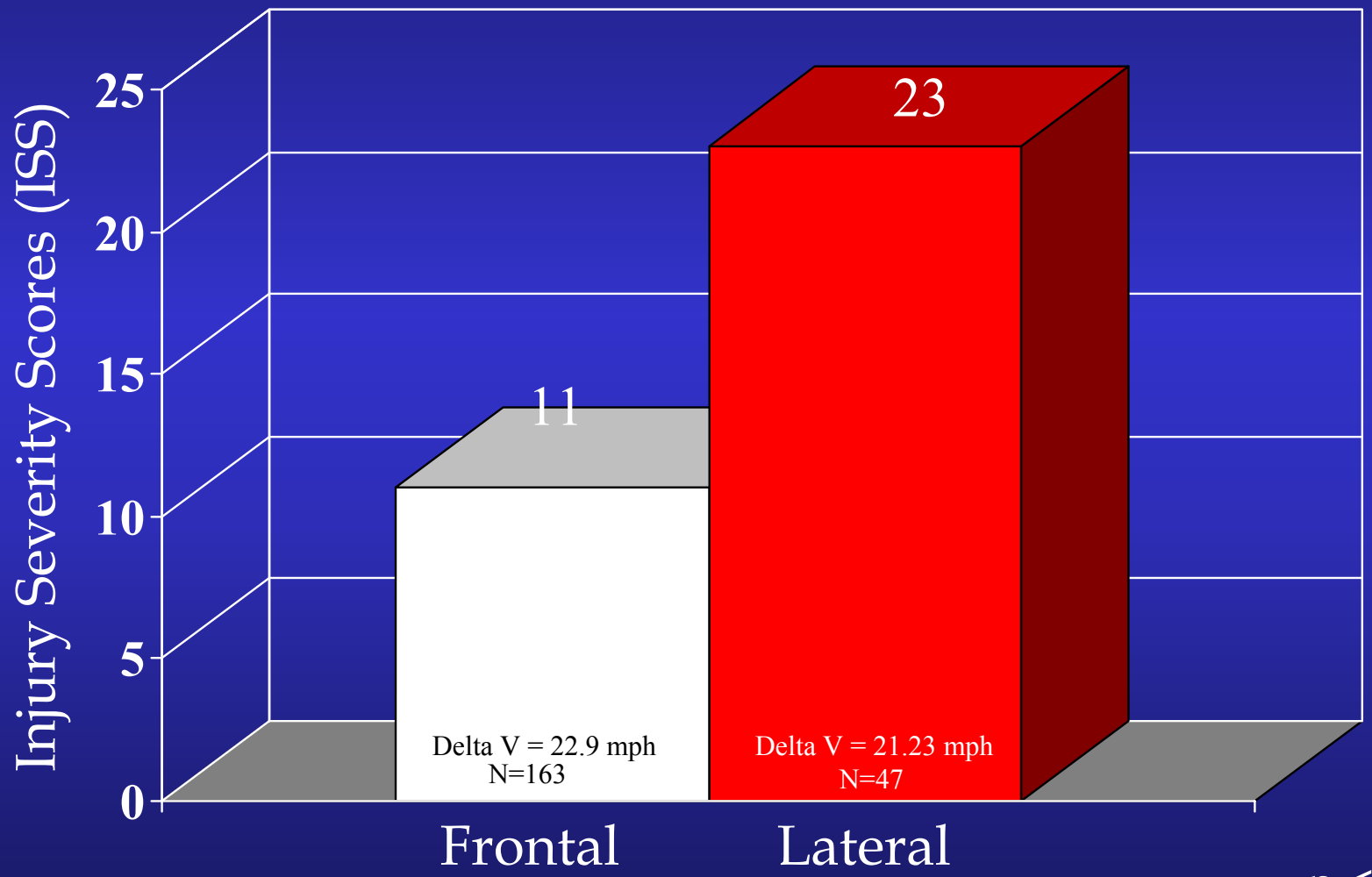
Frontal
(n=145)

%



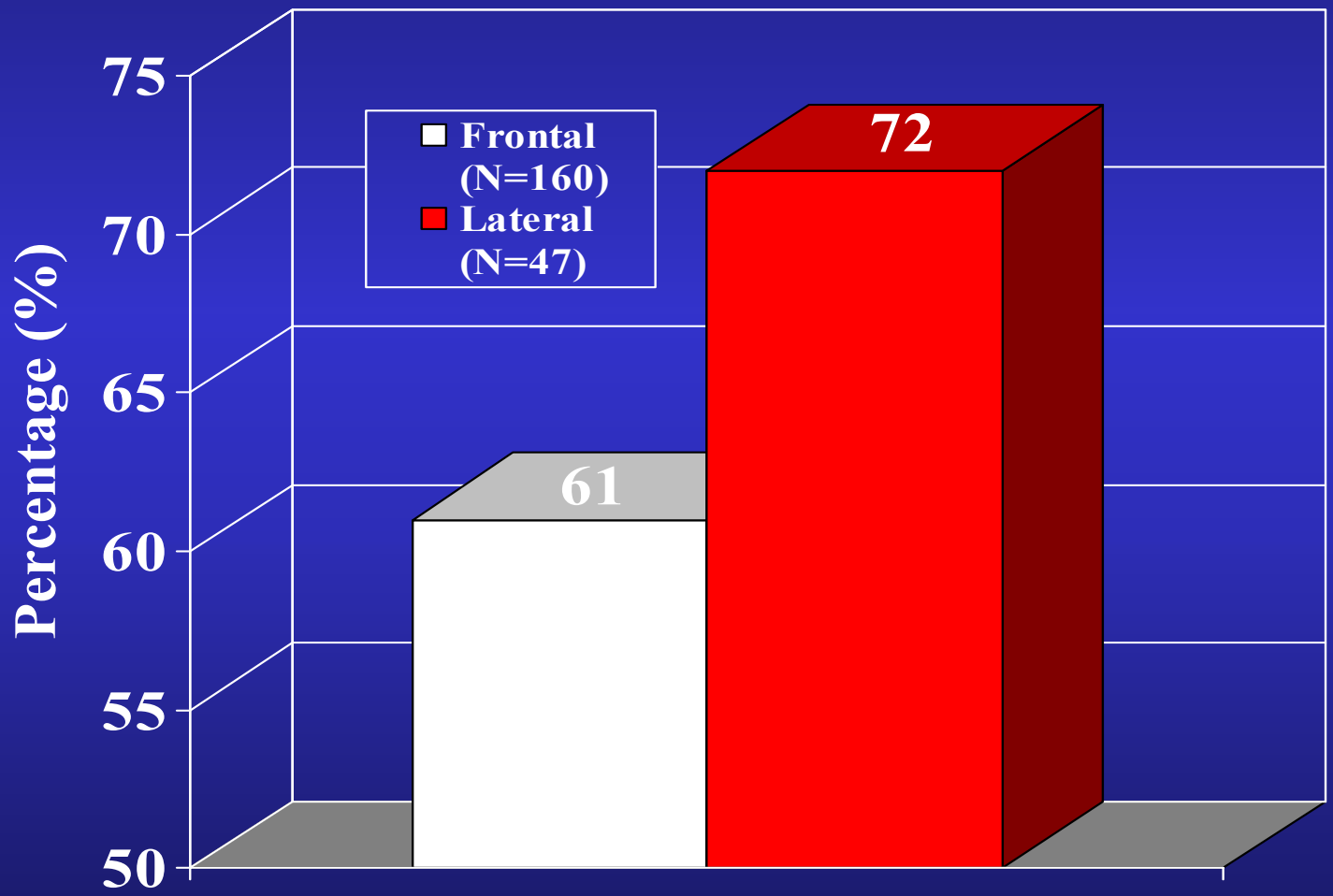
Lateral
(n=34)

Frontal vs. Lateral ISS:

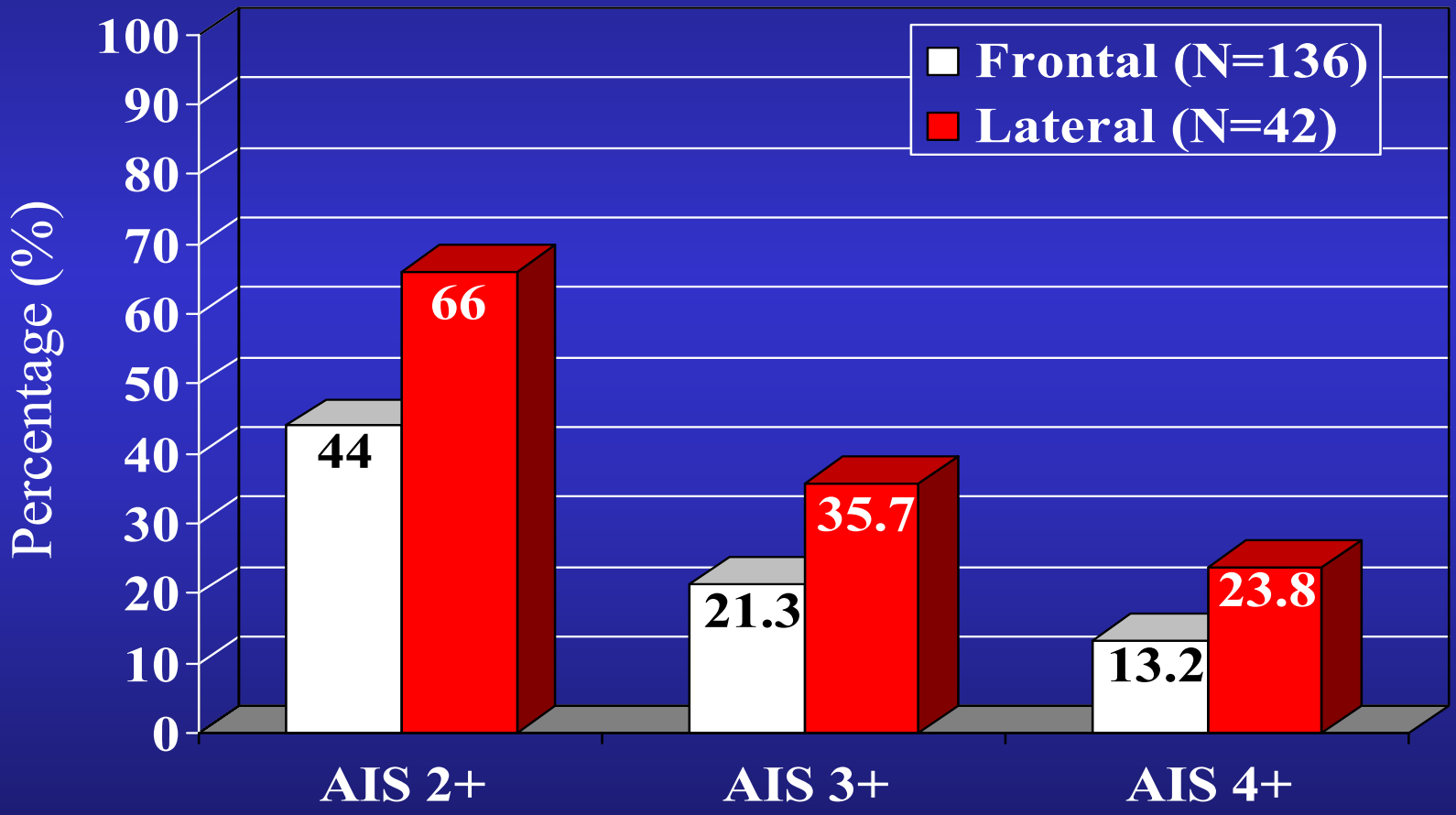


$p < 0.05$

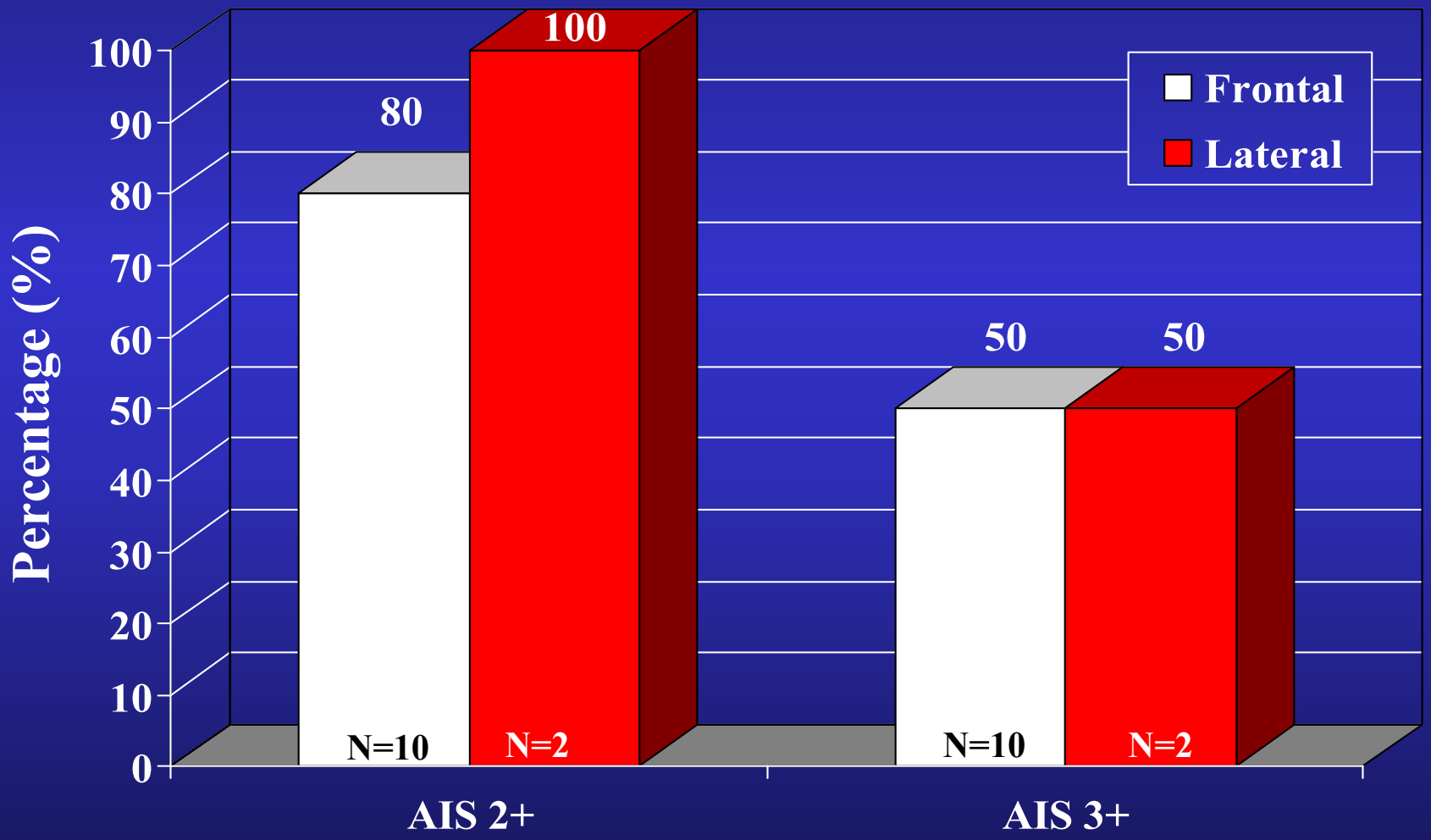
All Frontal vs. Lateral Any Head Injury



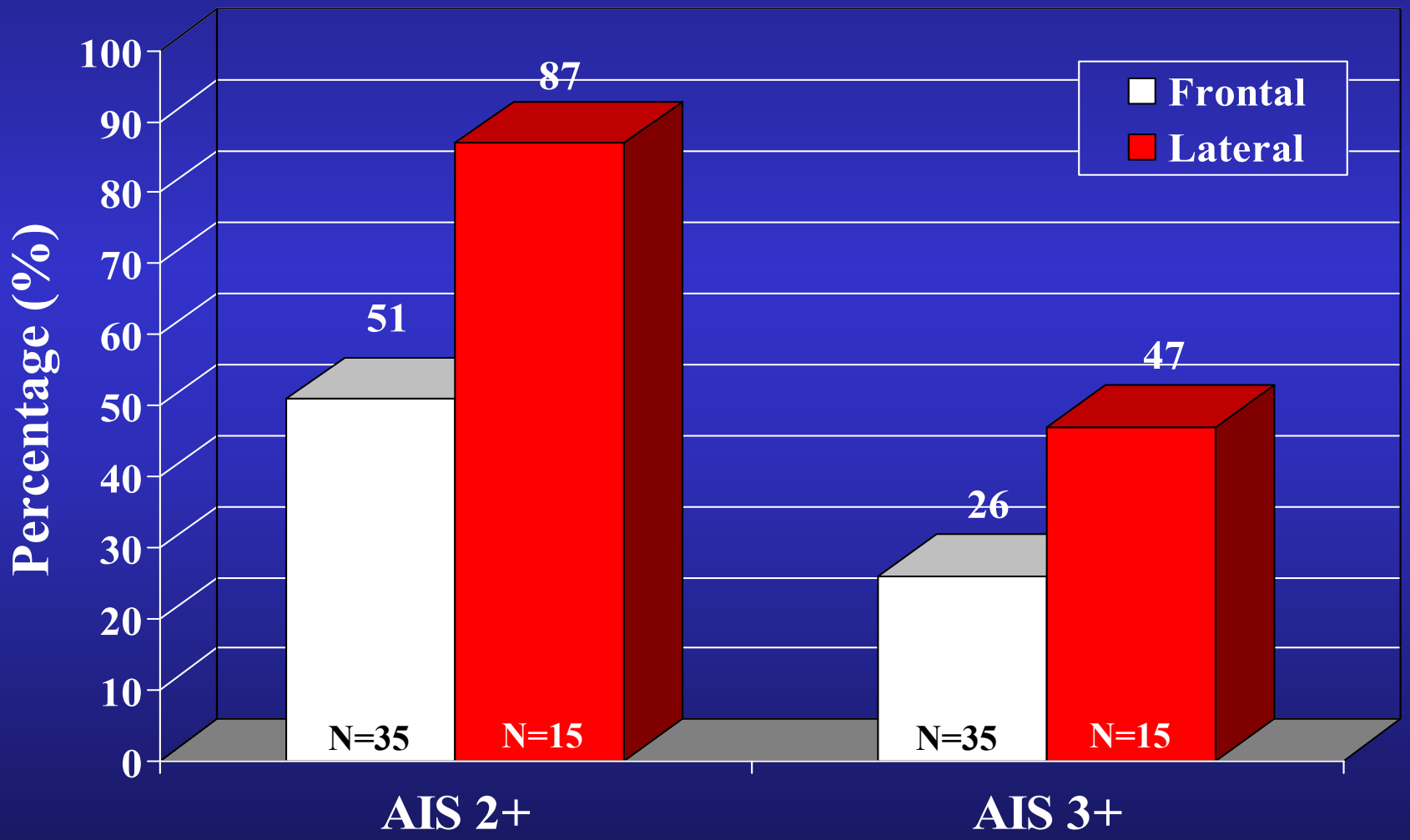
Frontal vs. Lateral Head Injury - AIS Score



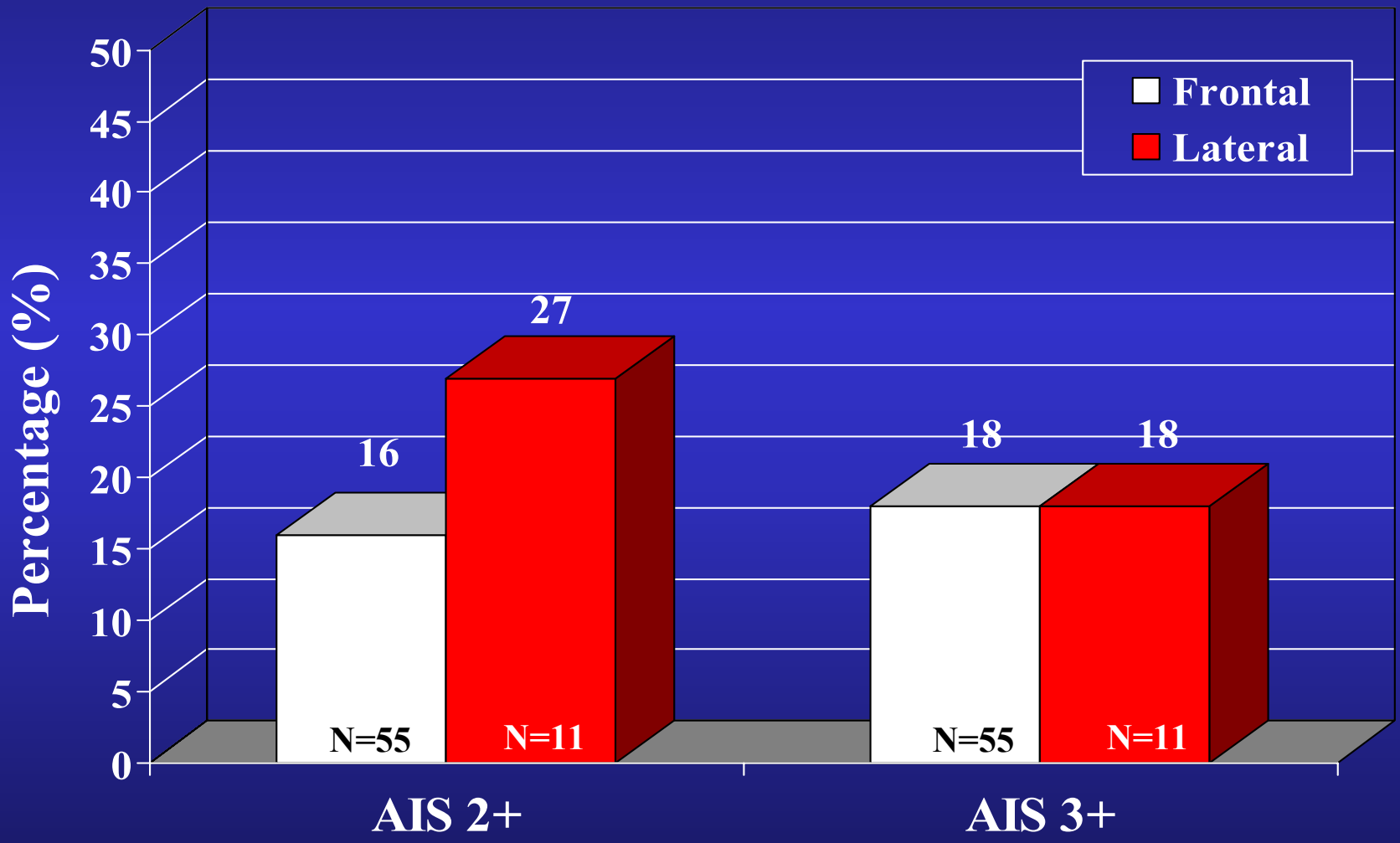
Rear Facing Seat Head Injury



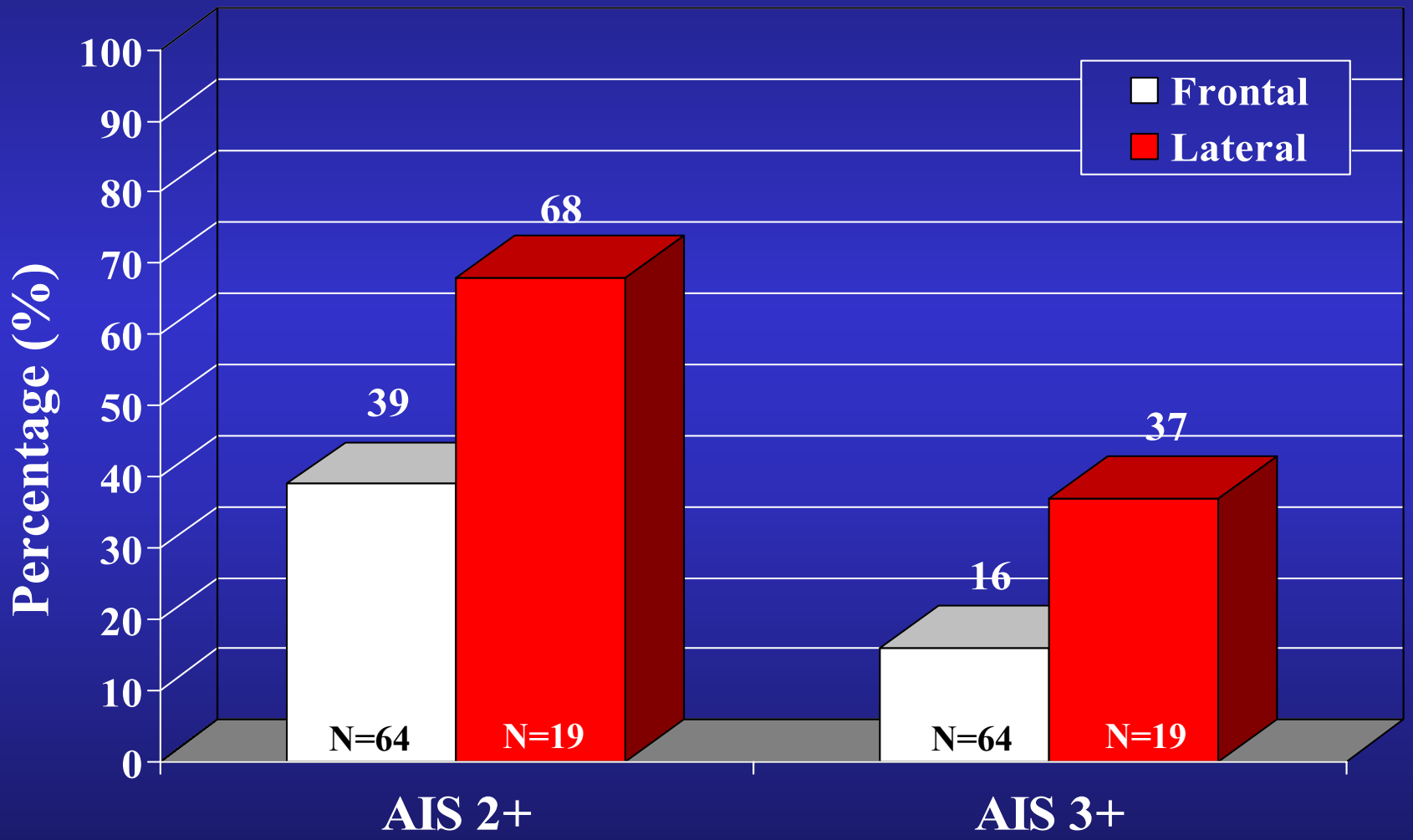
Forward Facing Seat Head Injury



Lap Belt Only
Head Injury



3-Point Belt Head Injury



The Lateral Crash

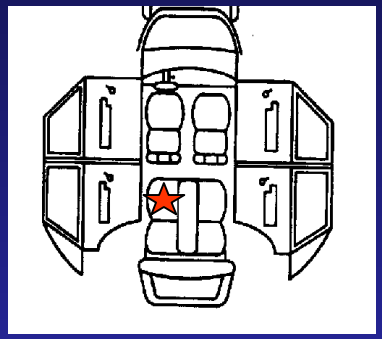
- More severe injury severity with all restraint types
- Head injuries are more common
  - account for a great proportion of severe head injury

Case Example

Appropriate restraint use in the worse crash situation: lateral impact

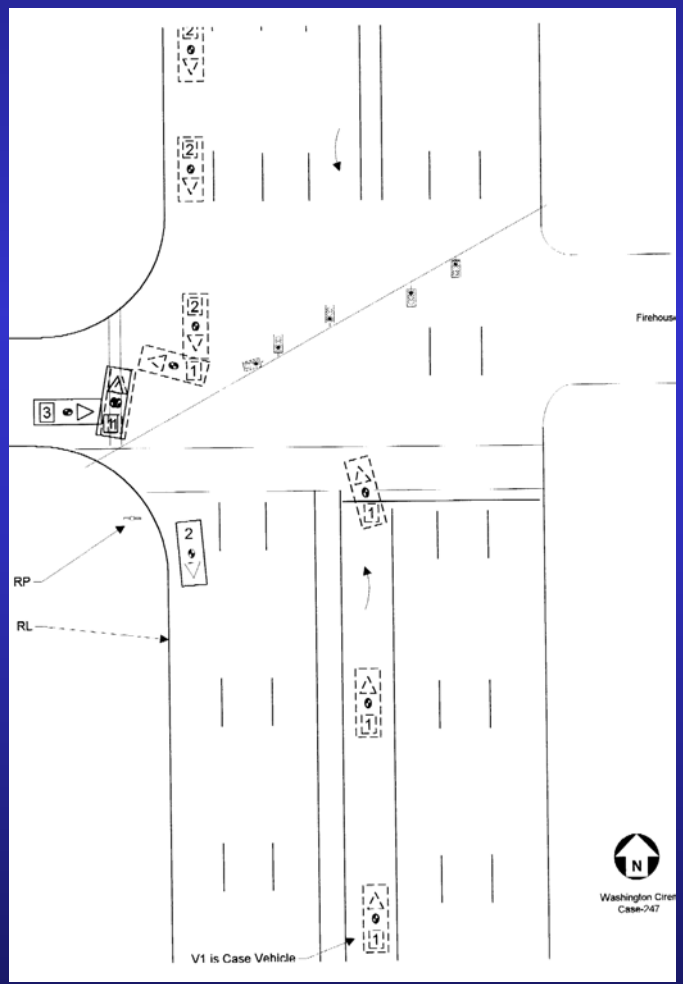
Case Example: Lateral Impact - Booster

- **Lateral Impact**
- **5-year old male**
- **53 lbs., 46 in.**
- **Left Rear Passenger**
- **Belt-positioning Booster**
- **Appropriate**



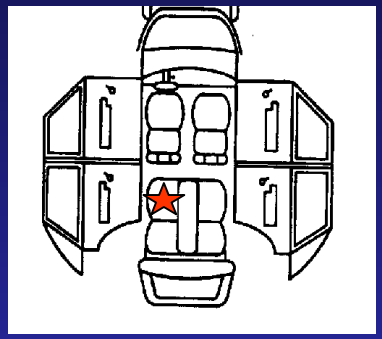
Scene and Auto

Crash Investigation



- 1990 Chevy Celebrity Station Wagon
- Lateral Impact

- Max Crush: 11 in.
- Delta V: 12.8 mph
- PDOF: +270

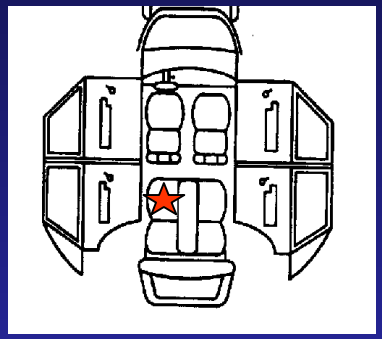


Intrusion

Crash Investigation

Case Occupant Seat

C-Pillar Contact

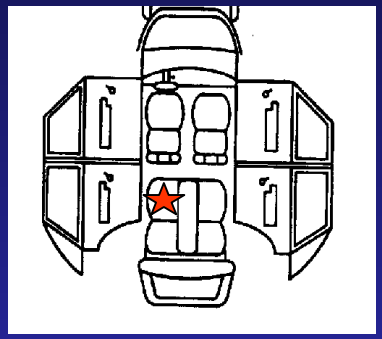


Intrusion

Crash Investigation

Case Occupant Seat

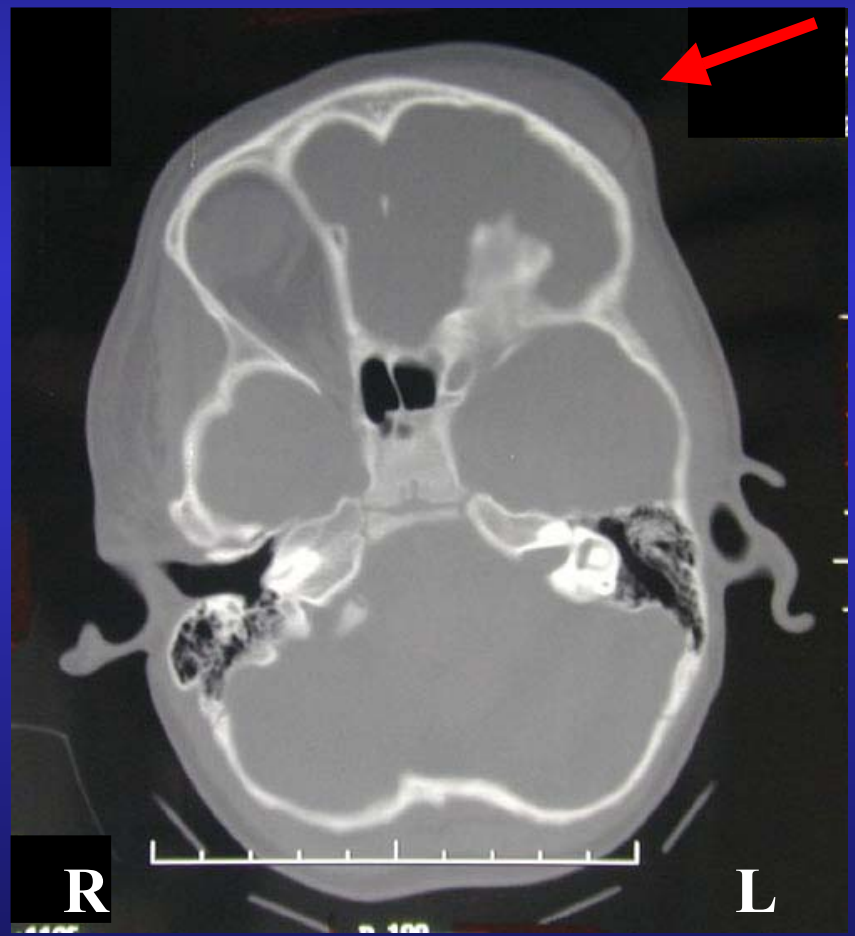
Case Occupant Booster

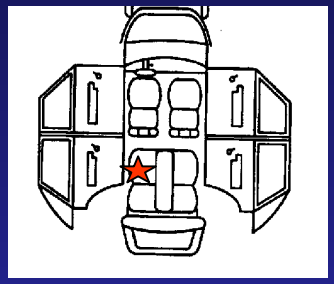


CT Impressions - Day 1

Normal Brain CT

Soft Tissue Swelling





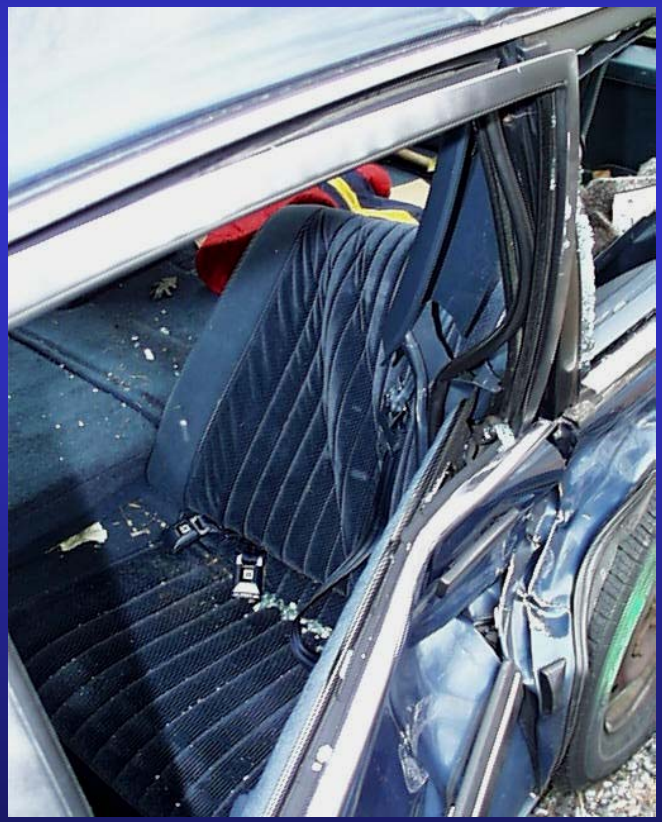
MRI Impressions - Day 6

Posterior Medial Inferior Temporal Gyrus Contusion

Left Insula & Left Frontal Lobe Shearing

Putting It All Together:

Lateral Impact



C-Pillar Intrusion

Booster Seat Protection

Conclusions

- 4-8 Year Olds
- Safety Seats
- Head Size
- Lateral Impact

Poor Restraint Selection

Poor Head Protection

Risk of Head Injury

Injury Severity

Future Considerations

- **Engineering:**
  - **Restraint design improvements**
  - **Head protection in rear & forward CSS**
- **Public Health/Education**
  - **Appropriate restraint use ~ 4-8 yr. old**
  - **Backseat ridership ~ < 12 yr. old**